HEPA, ULPA & Sealed Systems: The Complete Guide to Vacuum Filtration Standards

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Guide No. 02
HEPA, ULPA & Sealed Systems
True HEPA means 99.97% at 0.3 microns. Learn why "HEPA-type" is just marketing, and why the sealed system matters more than the filter.
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Executive Summary

"HEPA" is one of the most-used - and most-misunderstood - words in the cleaning aisle. This guide explains what vacuum filtration terms actually mean under the standards that govern them: the U.S. Department of Energy's **DOE-STD-3020** and **IEST-RP-CC001** testing protocol, and the European **EN 1822** / international **ISO 29463** classification systems. You'll learn why true HEPA means **99.97% efficiency at 0.3 microns**, why 0.3 microns is the *hardest* particle to catch rather than the smallest, how "HEPA-type" differs from certified HEPA, where **ULPA** and **MERV** fit, and - most importantly - why a **sealed system** matters more than the filter alone. No brands, no rankings; just the standards and how to read a spec sheet.

Introduction: Why This Topic Matters Now

Filtration language has crept onto nearly every vacuum, air purifier, and HVAC filter sold. Shoppers see "HEPA," "True HEPA," "HEPA-type," "99% HEPA," "sealed HEPA," and "ULPA" - often on competing products at very different price points. Because the U.S. Environmental

Protection Agency (EPA) links finer filtration to reducing airborne particles that can aggravate asthma and allergies, these labels carry real weight for health-conscious buyers.

The problem: the labels are only as meaningful as the standard behind them. This guide translates the standards into plain English so you can evaluate a filtration claim on evidence, not marketing.

Background: What "HEPA" Actually Means

HEPA stands for **High-Efficiency Particulate Air** (filter). In the United States, the benchmark comes from the Department of Energy. **DOE-STD-3020** defines a HEPA filter as one that "shall exhibit a minimum efficiency of **99.97% at a test aerosol diameter of 0.3 micrometer**." The testing methodology used to certify that performance in North America is **IEST-RP-CC001**, published by the Institute of Environmental Sciences and Technology (IEST), which classifies filters across roughly eleven efficiency levels from 99.97% up to 99.9999%.

Two things follow immediately:

1. **"HEPA" is a performance threshold, not a brand.** A filter either meets 99.97% at 0.3 µm (by a recognized test) or it doesn't.
2. **The standard is stable.** DOE-STD-3020 has been revised only occasionally (1997, 2005, 2015), which is exactly why this is durable, evergreen knowledge.

The 0.3-Micron Myth (and the MPPS Concept)

The single biggest misconception is that HEPA "can't catch anything smaller than 0.3 microns." The opposite is closer to the truth.

Filters don't get steadily worse as particles shrink. There is a specific size - the **Most Penetrating Particle Size (MPPS)** - at which a filter is *least* efficient, and for HEPA media that size sits around **0.15 microns**. Particles both larger *and* smaller than the MPPS are generally captured **more** easily, because different physical mechanisms (impaction and interception for larger particles; diffusion for smaller ones) take over. The European/international standards (**EN 1822** and **ISO 29463**) grade filters precisely at this most-penetrating size.

So testing at 0.3 microns is a deliberately demanding benchmark near the worst-case region - not a floor below which the filter fails. A true HEPA filter typically captures ultrafine particles *and* larger ones at high efficiency.

The Standards Landscape: US vs. Europe/International

There are two main frameworks, and they classify slightly differently:

- **United States (DOE-STD-3020 / IEST-RP-CC001):** HEPA = ≥99.97% at 0.3 μm; higher grades run up to 99.9999%.
- **Europe (EN 1822) and International (ISO 29463):** filters are graded at the MPPS into families -
    - **EPA (E10–E12):** "Efficiency Particulate Air" - roughly 85% to <99.5%.
    - **HEPA (H13–H14):** approximately 99.95% to 99.995% at MPPS.
    - **ULPA (U15–U17):** up to about 99.999995% at MPPS.
- ISO 29463 mirrors this with 13 classes (ISO 15E to ISO 75U). Since 2019, EN 1822 references ISO 29463 for test methods while keeping its class names.

Note that European "EPA" (E10–E12) is a *filter grade*, not the U.S. Environmental Protection Agency - a common point of confusion worth flagging for readers.

ULPA vs. HEPA

ULPA stands for **Ultra-Low Particulate (or Penetration) Air**. ULPA filters (EN 1822 classes U15–U17) capture an even higher percentage of particles at the MPPS than HEPA - up to around **99.999995%**. They're common in cleanrooms and semiconductor or pharmaceutical environments.

More filtration isn't automatically "better" for a home vacuum, though: denser media means more airflow resistance, which can reduce suction unless the machine is engineered for it. For most households, certified HEPA-grade filtration in a well-sealed machine is the relevant target; ULPA is largely an industrial/cleanroom specification.

"True HEPA" vs. "HEPA-Type": The Label Trap

Here's where shoppers get caught. Terms like **"HEPA-type," "HEPA-like," "HEPA-style," or "99% HEPA"** are **marketing descriptors, not certified grades.** They suggest resemblance to HEPA without a guarantee of meeting the 99.97%-at-0.3-μm threshold under a recognized test. Because the bare word "HEPA" is not uniformly enforced on every consumer product, the safest approach is to look past the adjective and ask for the **tested efficiency and particle size**, ideally referencing DOE/IEST or EN/ISO.

A practical rule: if a product states a specific efficiency *and* particle size (e.g., "99.97% at 0.3 μm") or an EN/ISO class (e.g., "H13"), that's a verifiable claim. If it only says "HEPA-type" with no number, treat it as unverified until you see the spec.

Why the Sealed System Matters More Than the Filter

This is the most important - and most overlooked - point. A HEPA filter only helps if **all the air actually passes through it.** The EPA is explicit that a HEPA vacuum "must be designed so that all the air drawn into the machine is expelled through the HEPA filter with none of the air leaking past it."

In other words, a genuine HEPA filter dropped into a leaky housing can underperform badly, because dust-laden air escapes around the filter through seams, gaskets, or a loose bag door. This is the difference between a **"sealed system"** (sometimes "sealed HEPA") and a machine that merely *contains* a HEPA filter. When comparing vacuums, the sealed-system claim is arguably as important as the filter grade itself.

Where MERV Fits

You'll also see **MERV** (Minimum Efficiency Reporting Value), the rating used mainly for HVAC and furnace filters under **ASHRAE Standard 52.2**. MERV runs from **1 to 16** on the common scale, testing efficiency across several particle-size ranges. True HEPA sits **above the top of the standard MERV scale** - higher-efficiency filters are sometimes described in extended MERV-17-to-20 terms, but HEPA is properly defined by the DOE/IEST or EN/ISO systems, not MERV. For readers cross-shopping air purifiers and HVAC filters, the takeaway is simple: MERV and HEPA are *different scales*, and a high MERV number is not automatically HEPA.

Key Findings

1. **True HEPA = 99.97% at 0.3 µm** (DOE-STD-3020 / IEST-RP-CC001) - a threshold, not a brand.
2. **0.3 µm is the hard case, not the limit.** The MPPS (~0.15 µm) is where filters struggle most; smaller *and* larger particles are generally captured better.
3. **Two standards frameworks exist** - US (DOE/IEST) and EN 1822 / ISO 29463 - with EPA/HEPA/ULPA grades.
4. **"HEPA-type" is marketing.** Look for a stated efficiency + particle size or an EN/ISO class.
5. **Sealed system > filter alone.** Air must pass *through* the filter, not around it.
6. **MERV ≠ HEPA.** Different scale, different application.

Practical Implications for Buyers

- **Read the number, not the adjective.** Prefer specs stating efficiency *and* particle size, or an EN/ISO class (H13/H14).

- **Ask about the seal.** A "sealed system"/"sealed HEPA" claim addresses leakage the filter grade can't.
- **Match filtration to need.** Certified HEPA-grade is the sensible home target; ULPA is industrial.
- **Maintain it.** Even a certified filter fails its rating if clogged, torn, or improperly seated - follow the manufacturer's replacement schedule and use correct bags/filters.
- **Don't confuse scales.** MERV (HVAC) and HEPA (DOE/EN/ISO) aren't interchangeable.

Historical Context: From the Manhattan Project to the Cleaning Aisle

HEPA technology traces to mid-20th-century efforts to filter fine radioactive particles, later formalized for critical DOE facilities and codified in standards like DOE-STD-3020 and IEST test protocols. Over decades, the terminology migrated into consumer products - which is exactly why the word now needs translating: a term engineered for nuclear-grade containment is printed on household boxes without the same testing rigor behind every use.

Future Outlook

Expect the **US and international systems to converge in practice** as EN 1822 continues to reference ISO 29463 test methods, and expect **more scrutiny of "type" language** as buyers grow standards-literate. Filtration will remain a headline feature for vacuums and air purifiers, keeping the sealed-system distinction commercially important. The underlying thresholds, however, are stable - which is what makes standards knowledge a lasting advantage for shoppers and service pros alike.

Data Tables & Visual Breakdowns

Table 1 - Filtration grades at a glance

Grade family	Standard	Approx. efficiency	Typical use
EPA (E10–E12)	EN 1822 / ISO 29463	~85% to <99.5% (at MPPS)	General fine filtration
HEPA	DOE-STD-3020 (99.97% @ 0.3 µm); EN 1822 H13–H14	~99.95%–99.995%	Homes, healthcare, labs

ULPA (U15–U17)	EN 1822 / ISO 29463	up to ~99.999995% (at MPPS)	Cleanrooms, semiconductors
MERV 1–16	ASHRAE 52.2	Ranges by particle size	HVAC/furnace filters

Sources: DOE-STD-3020; EN 1822; ISO 29463; ASHRAE 52.2. Values are standard reference figures, not product claims.

Suggested infographic - micron scale with 0.3 µm (HEPA test point) and ~0.15 µm (MPPS) marked against common particles. **Flowchart - "Is it true HEPA?"** Ask: Does it state efficiency + particle size? Is there an EN/ISO class? Is the *system* sealed? **Checklist - spec-reading:** efficiency %, particle size, test standard, EN/ISO class, sealed-system claim, filter replacement interval.

Expert Interpretation / Strategic Commentary

For anyone who services vacuums, the recurring real-world lesson is that **the housing and seals decide whether a great filter performs like one.** A certified HEPA element in a machine with a leaking bag door or degraded gasket can let dusty air bypass the media entirely. That's why professionals evaluate filtration as a *whole-machine* property - filter grade, seal integrity, and maintenance together - rather than judging by the word on the box. The most useful thing a shopper can do is demand the number and the seal, then keep the filter maintained to spec.

FAQ

What does HEPA actually stand for? High-Efficiency Particulate Air. Under DOE-STD-3020, a HEPA filter must capture ≥99.97% of particles at 0.3 microns, verified by testing such as IEST-RP-CC001.

Is "HEPA-type" the same as true HEPA? No. "HEPA-type," "HEPA-like," and "99% HEPA" are marketing terms with no guaranteed certified threshold. Look for a stated efficiency and particle size, or an EN/ISO class (H13/H14).

Why is HEPA tested at 0.3 microns if smaller particles exist? Because ~0.3 µm is near the *hardest* size to capture (the Most Penetrating Particle Size is ~0.15 µm). Particles larger and smaller are generally filtered more efficiently.

Is ULPA better than HEPA? ULPA captures a higher percentage at the most-penetrating size and is used in cleanrooms, but its denser media can restrict airflow. For homes, certified HEPA-grade in a sealed system is the practical target.

What is a sealed HEPA (sealed-system) vacuum? One engineered so all air is forced through the HEPA filter with none leaking around it - the EPA's requirement for a HEPA vacuum to actually deliver its rating.

Is a high MERV rating the same as HEPA? No. MERV (ASHRAE 52.2, scale 1–16) rates HVAC filters. HEPA is defined by DOE/EN/ISO standards and sits above the standard MERV scale.

Conclusion

Vacuum filtration labels are only as trustworthy as the standards behind them. "True HEPA" has a precise meaning - **99.97% at 0.3 microns** under DOE/IEST, or H13–H14 under EN 1822/ISO 29463 - while "HEPA-type" is a marketing adjective to verify, not trust. Remember that 0.3 microns is the *tough* case, not the limit; that ULPA is largely an industrial grade; that MERV is a separate HVAC scale; and above all, that a **sealed system** is what lets any filter perform as rated. Read the number, check the seal, and maintain the filter - and the spec sheet stops being marketing and starts being information.

This article is educational and does not constitute product-purchase or medical advice.